1. Go to: http://LCatalytics.com

2. Create instructor account

3. After logging in, click the “Student view” tab

4. Join session 301431
Learning Catalytics: Socrates Meets Facebook and High Academic Standards

BLC 2013
Boston, MA, 22 July 2013
Think of something you are good at
Now think how you became good at it
better pay attention!
What happens in a lecture?
education
some people talk in their sleep
some people talk in their sleep

lecturers talk while other people are sleeping

(Albert Camus)
education
The result?
education is not just information transfer
education is not just information transfer

1991–1994
FCI pretest

score

count
education is not just information transfer
change in score, $S_f - S_i$ (%)

initial score, $S_i$ (%)
The diagram shows the change in score, $S_f - S_i$, as a function of the initial score, $S_i$, for the year 1990 combined. The x-axis represents the initial score, $S_i$, in percentage, ranging from 0 to 100. The y-axis represents the change in score, $S_f - S_i$, also in percentage, ranging from 0 to 100. The data points suggest a trend where the change in score increases as the initial score increases.
change in score, $S_f - S_i$ (%) vs. initial score, $S_i$ (%)
change in score, $S_f - S_i$ (%) vs. initial score, $S_i$ (%)

only one quarter of maximum gain realized

\[ g = \frac{S_f - S_i}{1 - S_i} \]

not transfer but assimilation of information is key
1. transfer of information
1. transfer of information

2. assimilation of that information
1. transfer of information (in class)

2. assimilation of that information
1. Transfer of information (in class)

2. Assimilation of that information (out of class)
1. transfer of information (in class)

2. assimilation of that information (out of class)

Should focus on THIS!
1. transfer of information (in class)

2. assimilation of that information (out of class)
1. transfer of information (out of class)

2. assimilation of that information (in class)
1. transfer of information (out of class)

2. assimilation of that information (in class)
question

think

poll
Let's try it!
thermal expansion
all of them
Consider a rectangular metal plate with a circular hole in it.
Consider a rectangular metal plate with a circular hole in it.

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.
Consider a rectangular metal plate with a circular hole in it.

When the plate is uniformly heated, the diameter of the hole:

1. increases
2. stays the same
3. decreases.
Consider a rectangular metal plate with a circular hole in it.

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.
Before I tell you the answer...
Before I tell you the answer, let’s analyze what happened.
Before I tell you the answer, let’s analyze what happened.

You...
Before I tell you the answer, let’s analyze what happened.

You…

1. made a commitment
Before I tell you the answer, let’s analyze what happened.

You...

1. made a commitment
2. externalized your answer
Before I tell you the answer, let’s analyze what happened.

You…

1. made a commitment
2. externalized your answer
3. moved from the answer/fact to reasoning
Before I tell you the answer, let’s analyze what happened.

You...

1. made a commitment
2. externalized your answer
3. moved from the answer/fact to reasoning
4. became emotionally invested in the learning process
Consider a rectangular metal plate with a circular hole in it.

When the plate is uniformly heated, the diameter of the hole

1. increases.
2. stays the same.
3. decreases.
Consider a rectangular metal plate with a circular hole in it.

When the plate is uniformly heated, the diameter of the hole

1. increases. ✓
2. stays the same.
3. decreases.
consider atoms at rim of hole
consider atoms at rim of hole
consider atoms at rim of hole
consider atoms at rim of hole

you won't forget this
is it any good?
first year of implementing PI

1991 FCI pretest

score

count

0 5 10 15 20 25

0 5 10 15 20 25

0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25

education  PI  test
first year of implementing PI

1991 FCI posttest

count

score
first year of implementing PI

1991 combined

education

PI

test
change in score, \( S_f - S_i \) (%)

initial score, \( S_i \) (%)

\[ g = \frac{S_f - S_i}{1 - S_i} \]
change in score, $S_f - S_i$ (%)

initial score, $S_i$ (%)

g = \frac{S_f - S_i}{1 - S_i}$
The graph shows the relationship between the initial score, $S_i$, and the change in score, $S_f - S_i$, as a percentage. The equation for $g$, the gain, is given by:

$$g = \frac{S_f - S_i}{1 - S_i}$$

The data points represent the change in scores with respect to the initial scores. R.R. Hake, *Am. J. Phys.* 66, 64 (1998)
what about problem solving?
1985 exam scores

Exam score (%)

Count

0 5 10 15 20 25
0 20 40 60 80 100

education
PI
test
1991
exam scores

count

exam score (%)

0 20 40 60 80 100

0 5 10 15 20 25
1985/91 exam scores
So better understanding leads to better problem solving!
So better understanding leads to better problem solving!

(but “good” problem solving doesn’t always indicate understanding!)
in a lecture, students...
in a lecture, students...

1. don’t pay utmost attention
in a lecture, students…

1. don’t pay utmost attention


doi: 10.1109/TBME.2009.2038487
1. don’t pay utmost attention in a lecture.

doi: 10.1109/TBME.2009.2038487
1. don’t pay utmost attention

doi: 10.1109/TBME.2009.2038487
1. don’t pay utmost attention
in a lecture, students...

1. don’t pay utmost attention

2. think they know it
in a lecture, students...

1. don’t pay utmost attention
2. think they know it
3. are not confronted with misconceptions
in a lecture, students...

1. don’t pay utmost attention
2. think they know it
3. are not confronted with misconceptions

false sense of security
an illusion...
Education is not just about:

• transferring information

• getting students to do what we do
Education is not just about:

- transferring information
- getting students to do what we do

active participation a must!
not technology, but pedagogy matters
PeerInstruction.net

Join now!
Peer Instruction: Practical Details

ERIC MAZUR

BLC 2013
Boston, MA, 22 July 2013
Peer Instruction: Practical Details

@eric_mazur

BLC 2013
Boston, MA, 22 July 2013
Peer Instruction: a primer

lectures focus on information transfer...
Peer Instruction: a primer

lectures focus on information transfer...

but education is much more!
Peer Instruction: a primer

1. information transfer
Peer Instruction: a primer

1. Information transfer
2. Assimilation of information
Peer Instruction: a primer

1. information transfer (easy and done in class)

2. assimilation of information (hard and left to student)
Peer Instruction: a primer

1. information transfer (out of class)
2. assimilation of information (in class)
use JiTT before class and PI in class!
“How much time to spend on each PI step?”
Peer Instruction: a primer

brief presentation
Peer Instruction: a primer

brief presentation

ConcepTest
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

> 70% correct
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

> 70% correct

explanation
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

> 70% correct

explanation

repeat from start
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

30–70% correct

> 70% correct

explanation

repeat from start
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

30–70% correct

peer discussion

> 70% correct

explanation

repeat from start
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

30–70% correct

peer discussion

clicker poll 2

> 70% correct

explanation

repeat from start
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

< 30% correct

30–70% correct

peer discussion

clicker poll 2

> 70% correct

explanation

repeat from start
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

< 30% correct

revisit concept

30–70% correct

peer discussion

clicker poll 2

> 70% correct

explanation

repeat from start
Peer Instruction: a primer

brief presentation

ConcepTest

clicker poll 1

< 30% correct

revisit concept

30–70% correct

peer discussion

clicker poll 2

> 70% correct

explanation

repeat from start
“Can this method be used in my class, where questions don’t necessarily have right answers?”
Bernard Gert (1934 – 2011)

Moral philosopher
Professor at Dartmouth

“Morality is an informal public system applying to all rational persons, governing behavior that affects others, and includes what are commonly known as the moral rules, ideals, and virtues and has the lessening of evil or harm as its goal.”
Let’s try it!

Bernard Gert (1934 – 2011)

Moral philosopher
Professor at Dartmouth
Bernard Gert’s moral system created by 10 rules:

1. Do not kill
2. Do not cause pain
3. Do not disable
4. Do not deprive of freedom
5. Do not deprive of pleasure
6. Do not deceive
7. Keep your promises
8. Do not cheat
9. Obey the law
10. Do your duty (as required by job, circumstances).
Heinz’s wife was near death, and her only hope was a drug that had been discovered by a pharmacist who was selling it for an exorbitant price. The drug cost $20,000 to make, and the pharmacist was selling it for $200,000. Heinz could only raise $50,000 and insurance wouldn’t make up the difference. He offered what he had to the pharmacist, and when his offer was rejected, Heinz said he would pay the rest later. Still the pharmacist refused. In desperation, Heinz broke into the store and stole the drug.
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Should Heinz have broken into the store to steal the drug for his wife?
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Should Heinz have broken into the store to steal the drug for his wife?

1. Yes
2. No
Let’s try it!

Bernard Gert’s moral system created by 10 rules:

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2. Do not cause pain
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5. Do not deprive of pleasure
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7. Keep your promises
8. Do not cheat
9. Obey the law
10. Do your duty (as required by job, circumstances).

Should Heinz have broken into the store to steal the drug for his wife?

1. Yes
2. No

you got all engaged!
Let’s try it!

Don’t need a correct answer!
“How can I be sure that my students will prepare for class?”
Getting students to read

Students do not come to class prepared, because...

1. they don’t have time.
2. they are not motivated to learn.
3. their instructors take away the incentive.
4. they do not have the requisite skills.
5. of some other reason.
6. They do come prepared in my class!

(select what you consider to be the main reason)
Getting students to read

Just-in-time-Teaching (JiTT)

www.jitt.org
Getting students to read

JiTT workflow

- topic 1
- reading assignment
Getting students to read

JiTT workflow

- topic 1 reading assignment
- online assignment
Getting students to read

JiTT workflow

topic 1 reading assignment

online assignment

2 conceptual questions
Getting students to read

JiTT workflow

- topic 1 reading assignment
  - online assignment
    - 2 conceptual questions
    - 1 feedback question
Getting students to read

JiTT workflow

- topic 1 reading assignment
- online assignment
- review feedback
- 2 conceptual questions
- 1 feedback question
Getting students to read

JiTT workflow

1. Topic 1 reading assignment
2. Online assignment
3. Review feedback
4. Address difficulties in class
5. 2 conceptual questions
6. 1 feedback question
Getting students to read

JiTT workflow

1. topic 1 reading assignment
2. online assignment
   - 2 conceptual questions
   - 1 feedback question
3. review feedback
4. address difficulties in class
5. repeat with next topic
Implementing PI & JiTT

“How is preparing a PI class different from preparing a lecture-based class?”
Implementing PI & JiTT

transitioning: where does the effort go?

- assign book for course
  - prepare lecture
    - deliver lecture
      - hand out assignment
        - repeat with next topic
          - final assessment
  - prepare/select ConcepTests
    - lead class discussion
      - hand out assignment
        - repeat with next topic
          - final assessment

- prepare reading assignment
  - review feedback
    - prepare/select ConcepTests
      - lead class discussion
        - hand out assignment
          - repeat with next topic
            - final assessment
Implementing PI & JiTT

transitioning: where does the effort go?

- assign book for course
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    - prepare/select ConcepTests
      - lead class discussion
        - hand out assignment
          - repeat with next topic
          - final assessment

Implementing PI & JiTT

New activities:

1. Reading assignment
2. ConcepTests
“How can I make sure all students participate?”
“When/which poll results do I show?”
“Will it work at my institution?”
It works here...
...but will it work here?
Will it work at my institution?

FCI normalized gain

\[ g = \frac{S_f - S_i}{1 - S_i} \]
Will it work at my institution?

FCI normalized gain

\[ g = \frac{S_f - S_i}{1 - S_i} \]
Will it work at my institution?

FCI normalized gain

normalized gain

<table>
<thead>
<tr>
<th></th>
<th>HU</th>
<th>JAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td>0.2</td>
<td>0.3</td>
</tr>
<tr>
<td>PI</td>
<td>0.5</td>
<td>0.3</td>
</tr>
</tbody>
</table>

The graph compares the FCI normalized gain for two institutions, HU and JAC, showing higher gain for HU.
Will it work at my institution?

FCI normalized gain

![Bar chart showing FCI normalized gain for HU and JAC institutions. The bars represent normalized gain values for T and PI categories.](chart.png)
Will it work at my institution?

exam performance

- HU
- JAC

<table>
<thead>
<tr>
<th></th>
<th>PI</th>
<th>T</th>
</tr>
</thead>
<tbody>
<tr>
<td>final exam score (%)</td>
<td>80</td>
<td>40</td>
</tr>
</tbody>
</table>
Will it work at my institution?

exam performance

![Bar chart showing final exam scores for HU and JAC institutions, with T and PI labels for two groups. The chart compares exam performance between the two institutions.]
Will it work at my institution?

student retention

<table>
<thead>
<tr>
<th>HU</th>
<th>JAC</th>
</tr>
</thead>
<tbody>
<tr>
<td>T</td>
<td></td>
</tr>
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</table>

dropped course (%)
Will it work at my institution?

student retention

![Graph showing student retention](image)

- HU: 25 dropped course (%)
- JAC: 0 dropped course (%)

- T: 10 dropped course (%)
- PI: 5 dropped course (%)
Will it work at my institution?

student retention

- HU
  - T: 10%
  - PI: 5%

- JAC
  - T: 20%
  - PI: 5%
Will it work at my institution?

similar learning gains in different environments
Implementing PI & JiTT

“How do I cover everything using this method?”
<table>
<thead>
<tr>
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<th>PI</th>
</tr>
</thead>
<tbody>
<tr>
<td>in-class coverage</td>
<td>complete</td>
<td>partial</td>
</tr>
<tr>
<td></td>
<td>traditional</td>
<td>PI</td>
</tr>
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<td>?</td>
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<td>material learned</td>
<td>little</td>
<td>substantial</td>
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## Implementing PI & JiTT

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<td>little</td>
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what good is coverage if little is retained?
“How do I write/find good questions for...?”
Books with ConcepTests:

- Physics (Prentice Hall)
Books with ConcepTests:

- Physics (Prentice Hall)
- Chemistry (Prentice Hall)
ConcepTests

Books with ConcepTests:

• Physics (Prentice Hall)
• Chemistry (Prentice Hall)
• Astronomy (Prentice Hall)
Books with ConcepTests:

- Physics (Prentice Hall)
- Chemistry (Prentice Hall)
- Astronomy (Prentice Hall)
- Calculus (Wiley)
ConcepTests

... or try searching Google:

<subject> “Peer Instruction”

<subject> ConcepTest

<subject> “Concept Test”

<subject> clickers
Funding:
National Science Foundation

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mazur.harvard.edu

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